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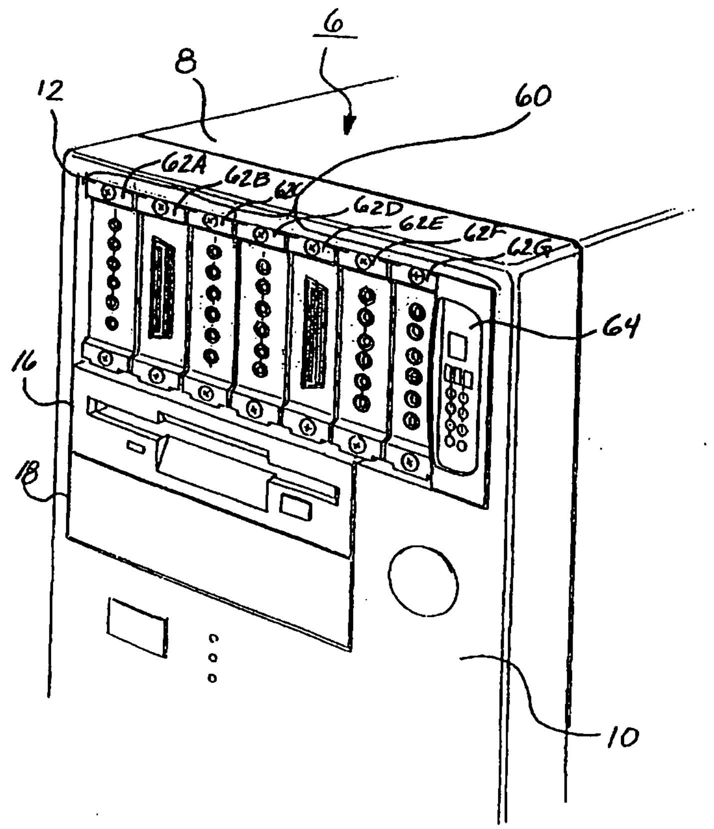
(54) Title: A MULTIFUNCTIONAL INPUT/OUTPUT SIGNAL MODULE FOR A GENERAL PURPOSE COMPUTER

(57) Abstract

A data acquisition and general system is disclosed for use in a computer (6). The system has at least one module (20) adapted for mounting in a floppy disc bay (12) of the computer (6) and can be removed therefrom. The module (60) has a number of slots that open forwardly of the module. The system also has one or more functional circuit (62) adapted for interchangeable and removable engagement within a slot. In particular, the functional circuit(s) (62) is a data acquisition and generation circuit having at least one electrical connector for receiving and providing a digital signal. It also has at least one electrical connector for receiving and providing an analog signal. Preferably, the functional circuit has an interface device that has a number of first predetermined connection device for coupling with a functional circuit, wherein the number of first connection device each are aligned with a corresponding one of the number of slots.



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A MULTIFUNCTIONAL INPUT/OUTPUT SIGNAL MODULE FOR A GENERAL PURPOSE COMPUTER

The present invention is directed to a data acquisition module for use in a general purpose computer, and, in particular, to a multi-functional, input/output signal module adapted for use in a floppy disc nacelle of a personal computer or workstation.

BACKGROUND

In the prior art, a data acquisition module for use in a floppy disc nacelle has been developed. Such a data acquisition module has been provided to enable data acquisition and generation for use in general purpose computers so that a general purpose computer can be used as a programmable test instrument, whereby input/output signals are provided to and from the personal computer. The data acquisition module is connected to the computer via one or more daughter boards provided in standard expansion slots in the motherboard of the computers. In turn, the daughter boards are connected to a signal processing sub-assembly also provided in one of the standard expansion slots of the mother board. The sub-assembly and the data acquisition module are operated so as to ensure the processing of one or more data input/output samples within a single sample time, that is, before the next data input/output is provided. By doing so, a real-time instrument emulator can be implemented. Such a system is disclosed in International Publication No. WO92/15959 published on 17 September 1992 (PCT Patent Application No. PCT/AU92/00076 lodged on 25 February 1992) in the name of the Applicant.

The prior art data acquisition module is provided as a rectangular box having electrical connections at a rearward portion for connection to the daughter boards inside the computer. The profile of the data acquisition modules is approximately that of a half-height, 5¼ inch floppy disc drive mountable in a floppy disc nacelle. Two such data acquisition modules are able to be mounted in a single, full height 5¼ inch floppy disc nacelle. Therefore, in a computer housing having four full-height, 5¼ inch floppy

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disc nacelles, from one to eight data acquisition modules are able to be fitted into such a computer cabinet. The functionality performed by such a data acquisition module is fixed. In fact, the input and output connectors on the front face of the data acquisition module are dependent upon the functionality of the module, thereby fixing the nature and number of connectors in the disc nacelle. The maximum analog input channel density for this data acquisition module is eight channels per module. The interface of the module based upon an 8-bit architecture, with the analog-to-digital conversion performed by the module having 12-bit resolution with conversion rates of up to 70K samples per second for each channel.

While providing a significant advance in the field of test instruments by enabling a general-purpose computer to be used as the basic structure of a user-programmable test instrument, it has been found that greater flexibility in the data acquisition module is needed to implement demanding functionality. Further, more flexible input/output channels are required to meet more demanding requirements of test instruments including medical testing equipment for example.

SUMMARY

It is an object of the present invention to overcome one or more of the disadvantages of the prior art system.

In accordance with a first aspect of the present invention, there is provided a data acquisition and generation system for a computer, said system comprising:

at least one module adapted for mounting in a floppy disc bay of said computer and being removable therefrom, said module having a plurality of slots that open forwardly of set modules; and

at least one functional circuit adapted for interchangeable and removable engagement within a slot of said plurality of slots. Preferably, the at least one functional circuit is a data acquisition in generation circuit having at least one electrical connector for receiving a digital signal, providing a digital signal, or both. Optionally, the at least one functional circuit is a data acquisition and generation circuit having at

least one electrical connector for receiving an analog signal, providing an analog signal, or both.

Preferably the at least one module comprises interface means for engagement with the at least one functional circuit and being electrically connected with the computer. Further, the interface means has a plurality of first predetermined connection means for coupling with a functional circuit, wherein the plurality of first connection means each are aligned with a corresponding one of said plurality of slots. Still further, the at least one functional circuit has a second predetermined connection means for mating engagement with a first predetermined connection means. Optionally, the at least one functional circuit comprises identification means for providing information about the at least one functional circuit to the interface means.

Preferably, the module comprises a front panel for manually operating said module and the at least one functional circuit, and for displaying information.

Preferably, two or more functional circuits are engaged in corresponding slots of said at least one module, each having a predefined interface for receiving electrical signals, providing electrical signals, or both. Further, the connector interface means for engagement with a predefined interface of each of the two or more functional circuits and for providing at least one application electrical connector for engagement with a signal coupling means, said at least one application electrical connector being coupled to the predefined interfaces.

BRIEF DESCRIPTION OF DRAWINGS

The preferred embodiment of the invention will now be described with reference to the drawings, in which:

Fig. 1 is a perspective view of a general-purpose computer housing having at least one multi-functional, input/output signal module according to the preferred embodiment;

Fig. 2 is a detailed diagram illustrating a number of minicards in a minirack module according to the preferred embodiment;

Fig. 3 is a perspective view of a single minirack card disposed for engagement with a backplane board of the module of Fig. 2; and

Fig. 4 is a bottom plan view of the computer housing;

Figs. 5 and 6 are perspective views illustrating an application-specific interface board for use with the multi-functional, input/output signal module according to the preferred embodiment; and

Figs. 7A and 7B are functional block diagrams illustrating the architecture of the minirack modules in use with a signal processing sub-assembly.

DETAILED DESCRIPTION

A general-purpose computer 6 is illustrated in Fig. 1, which can be an IBM-compatible personal computer, a workstation, or the like. The computer 6 has a tower-style cabinet 8 enclosing the computer. The front panel 10 of the cabinet 8 has four floppy disc nacelles 12, 14, 16 and 18 provided towards the front of the computer 6. Two conventional 3½ inch floppy disc drives are illustrated in the corresponding 3½ inch, half-height floppy disc nacelles 16 and 18. Two further full-height, 5¼ inch floppy disc nacelles 12 and 14 are also provided. A cover panel is provided in the 5¼ inch floppy disc nacelle 12. A multi-functional, input/output signal module 20 (hereinafter, simply referred to as the "minirack" module) according to the preferred embodiment is provided in nacelle 14. A number of other minirack modules 30, 40 and 50 are illustrated besides the cabinet 8 of the computer 6 to generally indicate the stacked arrangement of the minirack modules 30, 40 and 50 within the computer 6. While Fig. 1 indicates that the depth of the computer 6, as well as its width, is substantially similar to that of the minirack modules 30, 40 and 50, this generally will not be the case. Fig. 4 provides a bottom plan view of the computer 6 and, in particular, of the cabinet 8.

One or more of the minirack modules can be daisy-chained preferably via the daughter boards (not shown) to the signal processing sub-assembly (see Figs. 7A and 7B). The minirack module 20 of Fig. 1 preferably has seven slots for receiving

removable "minicards" to be received in the minirack module 20 as well as a fixed minicard for providing a front panel to the module 20. As shown in Fig. 1, the minirack module 20 has seven slots arranged in parallel from left to right with the fixed card having a front panel with indicators and input buttons on the right hand side. The first seven slots from the left are shown with moulded plastic covers that are separately removable and engageable.

In Fig. 2, a single minirack module 60 is illustrated in the computer 6. The minirack module 60 is illustrated with seven minirack cards disposed therein having front connectors 62a to 62g. Further, a fixed front panel 64 having a display and input keys is illustrated at the right hand side of the minirack module 60. The front connectors 62a, 62c, 62d, 62f, and 62g each have preferably six analog input/output connectors implemented as circular female sockets. The minirack module 60 also has two digital input/output D-type connectors 62b and 62e. It will be appreciated by a person skilled in the art that differing numbers of analog connectors and/or digital connectors can be employed dependent upon the functionality of the corresponding minicard without departing from the spirit and scope of the present invention. Fig. 2 simply illustrates one possible combination of front end connectors for seven minicards. Further, the minirack module 60 can have any number of minicards in it a given time ranging from one to seven such minicards. Preferably, the last or eighth slot of the minirack module is reserved for a "fixed" card used for providing information via the front panel 64 in the right most slot.

Fig. 3 is perspective view of a single minicard 90 illustrated in relation to the backplane board 74, a power supply board 73 and a rear plate 72 of an exemplary minirack module 70, where the top, bottom, side and front walls are not illustrated to provide a simplified diagram of the internal structure of the minirack module 70. As might be expected, the upper and lower walls of the minirack module can be provided with grooves for longitudinally engaging the corresponding edges of each minicard to provide secure engagement therebetween.

The minicard 90 contains electronic circuitry to implement the acquisition and/or generation of one or more signals. The minicard 90 has a front end connector 62c having six analog input/output connectors. Thus, the minicard 90 preferably has six input/output channels. A moulded plastic cover 94, of the type illustrated in Fig. 1, can preferably be snappingly engaged with fittings provided on the front end cover 62c. The input/output signal of each of the six channels is processed by electronic circuitry on the minicard 90 so that a data sample for each channel is available each sample time. The minicard 90 is connected to the sub-assembly (not shown) via the backplane board 74 and the input and output buffer boards 80 and 82. The buffer boards 80 and 82 are preferably coupled via ribbon cable, well known to those skilled in the art, to the daughter board, which is coupled to the sub-assembly (not shown).

Preferably, the right most slot is adapted for the "fixed" minicard. The fixed card serves as the module controller for the minirack module and the backplane board may be adapted to allow the fixed minicard to control the address bus of the minicards as described below with reference to Figs. 7A and 7B.

The buffer boards 80 and 82 provide a bus connection to the data, control, and address bus of the signal processing sub-assembly. In turn, the buffer boards 80 and 82 have interface connectors for engagement with the backplane board 74. This is generally indicated by a socket on the right hand side of buffer board 80, for example, having a plurality of pins generally oriented in the direction of the backplane board 74. Further, a power supply board 73 for delivering power to each of the minicards in the minirack module 70 is interposed between the back panel 72 of the module 70 and the backplane board 74. The power supply board 73 provides conventional voltages and currents to supply sufficient power to each of the minicards.

The female edge connector socket 96 for mating engagement with the male edge connector socket 92 of the minicard 90 is provided in the backplane board 74. The socket 96 provides an electrical connection to the shared data bus of the other like sockets in the backplane board 74. This data bus is in turn coupled to the corresponding connectors of the buffer boards 80 and 82. A power socket 98 is also

correspondingly provided for the minicard 90 to delivery power to the minicard. The power connection on the minicard 90 being conventional is not shown to simplify the drawing. While only a single minicard 90 is illustrated in Fig. 3, it will be apparent to a person skilled in the art that up to an additional six minicards can be employed with the backplane board 74 provided in the minirack module 70. The rightmost socket of the backplane board is reserved for the fixed card connected to a front panel display (e.g., the control panel 64 of Fig. 2.).

Using this configuration of removably engageable minicards within the slots of the minirack module, a single minirack module can provide up to 42 input/output channels per module in the preferred embodiment. The interface of the minirack module 70 provided to each of the sockets of the backplane board 74 is preferably based upon a 16-bit architecture. However, it will be readily apparent to a person skilled in the art that other architectures can be practiced without departing from the scope and spirit of the present invention. Preferably, the analog-to-digital conversion performed on any one of the minicards (90) has up to 16-bit resolution and conversion rates of up to 50K samples per second are provided on each of the six channels of the minicard 90.

Thus, the minirack module 70 is a multi-functional, signal input/output module for use in combination with a general purpose computer to implement a user configurable, test instrument or controller. This enables the expandable accommodation of extra miniracks to suit a large number of applications. The minirack module is designed for use in a computer, which can have additional processor hardware, for implementing the functionality of various test instruments that can be configured by a user using software.

Each minirack module has the facility for insertion of several printed circuit board cards (the minicard 90) that can be inserted into and removed from the module without requiring the computer housing to be opened. The minicards engage a backplane board 74 that is positioned orthogonally to the longitudinal extent of the cards (90) in the rearward portion of the module 70. Each of the minicards can have

separate functionality. Via the backplane board 74, the module 70 is able to identify the particular minicard 90 and its functionality using identification means provided in the minicard 90. Preferably, this is implemented using a read-only memory (ROM) forming part of the electronic circuitry on the minicard 90. The ROM stores information that can be read via the socket 96/92 by the signal processing sub-assembly (not shown). The identification information can be provided to software running on the computer to configure the test instrument and support automatic hardware resource allocation.

The minicards 90 each contain a variety of elemental instrumentation units. The elemental instrumentation unit consists of electronic functionality implemented on the minicard in electronic hardware that can process a data sample from its input to its output in a single sample time, thereby providing determinate operation of the overall test instrument emulated by the computer, sub-assembly, and minirack modules. Each minirack module can contain a large number of elemental instrumentation functions, which can be connected to using the front panel of the computer. This can be done via connections to the individual minicard front end connector 62a to 62g.

The front panel configuration as shown in Figs. 2 and 3 allows the connection to individual instrumentation units of the corresponding minicard as required by the user for each task. This configuration provides maximum flexibility for use of the minirack module by a researcher or technical staff. Because the elemental functions of each elemental instrumentation unit on each minicard are implemented independently, each instrumentation unit output or input is digitised separately allowing software configuration of a wide variety of applications. Examples of instrumentation units that can be implemented on the minicards (90) include:

bio-sensor amplifiers and stimulus;

frequency counters;

amplifiers;

gated amplifiers;

binary signal input/outputs;

AM/FM demodulators;

modulation/demodulation, mains frequency driver;

step or motor controller;

PID controller;

fibre optic refractometry amplifiers;

intracranial, high-impedance, neural signal amplifiers;

data communications to external controllers;

LVDT sensor electronics;

clock generators;

strain gauge amplifiers;

digital to analog output;

isolated amplifiers;

PWM modulation and FSK modulation;

phase lock loop shaft encoder;

phase control of AC motors;

accelerometer amplifier;

pressure transducer interfaces;

data communications to external sensors; and

prototype PCB interfaces for customer applications.

Using such elemental instrumentation units, the minirack module can provide the components with which software programming, preferably using icons, emulates a wide range of instrumentation. The software programming has a unique and simple relationship with the suite of hardware instrumentation units implemented on the minicards 90.

Preferably, the software programming has one icon per instrumentation unit. Further, each icon can be coalesced into a macro icon that can then control a number of instrumentation units combined by the supervisory software during the design of the test instrument, which will represent the instrument.

The creation of an effective test instrument by interconnection of elemental instrumentation units on the minicard 90 is affected by the software programming executing on the personal computer (using icons) which graphically depicts the interconnections. This is facilitated by the mechanical design of the minicards within the minirack module(s). In particular, each elemental instrumentation unit on a minicard is connected with a front edge of the minicard. This allows the physical connection via the minicard 90 to other inputs or outputs of minicards in the minirack module and to the front panel 64 of Fig. 2. As previously described, a number of external connections can be made to the elemental instrumentation units via the input/outputs of the corresponding front end connectors 62a to 62g.

The minirack module 70 itself contains environment detectors to monitor temperature, for stable analog measurement. Also, the minirack module 70 monitors power output from the system for notification to the user of its improper use or other faults that may have occurred. The minirack module 60 of Fig. 2 has a special indicator panel 64 which has programmable visual alarm/status indicators to better direct the use of the multi-functional minirack module. The minirack module is particularly, advantageous in that a number of minicards can be installed and de-installed from the module without opening the PC, thereby differing significantly from conventional PC instrument modules which require that the cabinet of the computer be opened. The preferred embodiment thereby enables easier use and better serviceability of the emulated instrument. Further, each minicard has an identity that is read by the processor of the sub-assembly at start-up of the application software running on the personal computer. This identity is resolved to allow the programmer the use of known device resources on the machine. The user thus cannot create functions in the emulated test instrument that are not supported by the required hardware resources on the minicards. Further, as previously mentioned, a single minicard or a part of a minicard is represented as an icon on the graphical representation of the test instrument displayed on the screen of the monitor.

Figs. 5 and 6 illustrate another embodiment of the invention. While the front edge connectors 62a to 62f of the minirack module 60 of Fig. 2 provide maximum flexibility for a user, it may be the case that an application-specific interface is required by the user so that standard electrical connections can be used. This is provided in the preferred embodiment using an application-specific interconnect board 110. Preferably, a moulded panel cover 120 is also used in combination with the application-specific board 110. In Fig. 6, the plastic moulding cover 120 is shown connected to the front panel 10 of the computer 6. The panel cover 120 has a display panel 130 that is similar to the display panel 64 of Fig. 2, described above. Further, two conventional electrical connections 114a and 114b are provided in the moulded panel cover 120 via the openings 122a and 122b. Further, a visual indicator 116 is provided in an opening 126 for the specific application. Thus, using the plastic moulding 120 and the application specific interface board 110, a simplified interface is provided to the user more in line with a conventional interface.

Fig. 5 illustrates a number of front end connectors 100a to 100d (arranged in parallel) with the interface board 110 and the plastic moulding 120 of Fig. 6. The front end connectors 100A to 100D are shown having the moulded plastic ends of Figs. 2 and 3 for engagement with the corresponding individual covers 94. However, the moulded engagement pieces need not be practised with the moulded front cover 120. It will be apparent to a person skilled in the art that alternative configurations of the front connectors 100A and 1000D may be practiced or the engagement portions may be omitted altogether without departing from the scope and spirit of the present invention.

Fig. 5 has been simplified by removing the minicard module walls and the computer 6 to clarify the invention. The application-specific interface board 110 has two male connectors 112a and 112b arranged on a rearward side of the interface board 110, in this example, for engagement with the D-type digital connectors 102a and 102b of the front end connectors 100a and 100b of the corresponding minicards. Further, the front end connectors 100c and 100d of additional minicards are indicated using dash line in Fig. 5. It will be apparent to a person skilled in the art that analog connectors,

such as those of connector 62A in Fig. 2, can be practiced dependent on the requirements of the application-specific interface board 110 interface circuitry.

The application-specific board 110 is provided with interconnections for the standard female electrical connectors 114a and 114b on the front side of the application-specific board 110, opposite the corresponding male connectors 112a and 112b. Further, a push button 118 for actuation of the application-specific board 110 is provided on the front side. Apertures 122a, 122b, 126, and 128 are provided in the plastic moulding 120 for receiving the electrical connectors 114a and 114b, the visual indicator 116 and the button 118, respectively. As shown in Fig. 5, a standard male electrical connector 132 can then be inserted into either female electrical connector 114a or 114b.

Thus, the plastic moulding 120 provides a means of housing one or more application-specific interface boards 110 therein. The interface board 110 is used to connect conventional electrical connectors to the minirack module and to provide interface circuitry and/or connections between the analog and/or digital connectors of the front end connectors of the minicards. The application-specific board 110 can provide circuitry unique to a particular application as well as a front panel for mounting of industrial connectors that are often associated with a particular application. Examples of application specific connectors are the MS connectors for cardiac monitors or the D-connector for EEG's.

Further, the minicards 90 can contain circuit control elements (such as relays and other switches) and safety devices for input protection or signal output power boosting. The digital output from one minicard can also switch or otherwise treat an input to an amplifier of another minicard. For example, the minirack module can have digitally controlled switching for a neurology application which provides different reference signals, being the calibration pulses and the "lead-off" indication.

The supervisory computer software running on the sub-assembly specifically operates the minirack module(s) to provide a determinate execution time (or minimum execution time variance) by processing all icons representing elemental instrumentation

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units on the minicards and on the sub-assembly during a single sample time. This allows the implementation of complex transfer functions and control algorithms. For example, the supervisory software system can resolve feedback loops, or nested feedback loops which traverse the entire array of instrumentation units represented on the display. The instrumentation hardware included in each minicard of a minirack module of several minirack modules can advantageously be represented graphically in the supervisory computer software, so that it is not treated differently within an array implementing such feedback. From the user perspective, there is no difference in the user programming level between functions implemented on the signal processing sub-assembly and functions that are heavily reliant on the minicards.

Thus, the minirack module according to the preferred embodiment has two user "connection" interfaces. The first is a general purpose or generic device interface which allows the user direct connection to each minicard. The second is an application-specific panel interface provided in a moulded plastic cover which provides both a connection to each minicard and its elemental instrumentation unit with any industrial connection that the user requires.

Figs. 7A and 7B are functional block diagrams illustrating a number of minirack modules 720, 730 according to the preferred embodiment coupled to a signal processing sub-assembly 760 implemented in the computer. Fig. 7A shows a number of minirack modules 720, 730 connected to a minirack module bus 740. In turn, the minirack module bus 740 is connected to a minirack modules controller 710. The minirack module bus 740 is the electrical connection between the minirack modules 720, 730 contained in the floppy disc nacelles of the computer and serves to connect the modules with the signal processing sub-assembly contained in the computer, as will be described in detail below. Preferably, the minirack modules are connected in a daisy chain to the minirack modules controller 710.

The minirack module 720 comprises a number of minicards 726, 728, which are connected to an internal module address bus 724 and to the shared minirack module bus 740. Further, the minirack module 720 contains a module controller 722 which is

connected between the minirack module bus 740 and the internal module address bus 724. The minirack module 720 preferably has one fixed minicard, which implements the module controller 722, and up to seven other removable minicards 728. While the module controller 722 is preferably implemented as a "fixed" minicard connected to the backplane board 74, it could alternatively be implemented on the backplane board 74 without departing from the scope and spirit of the present invention. The other illustrated minirack module 730 has an identical construction. However, as discussed above, the elemental instrumentation units implemented on any particular minicard is dependent on the functionality of the minicard.

It will be appreciated by a person skilled in the art that the illustration of the minirack modules controller 710 in Fig. 7A is only a partial illustration and reference is now made to Fig. 7B. A sample clock (F_S) 712 is provided to the minirack modules controller 710. While the sample clock is illustrated as an input to the controller 710, the minirack modules controller preferably contains a clock signal generation circuit for generating the clock signal (F_S) 712. The clock signal 712 can be programmably set using a parameter specified using the graphical software programming. The minirack modules controller 710 is coupled to the signal processing sub-assembly 77 by bus 760 which is connected to the first digital signal processor (DSP) 772 of the sub-assembly 770. The minirack modules controller 710 is also coupled to a dual port memory 750. Preferably, the minirack modules controller 710 is implemented as part of the sub-assembly 770 itself. It will be apparent to a person skilled in the art that modifications to the implementation of the controller 710 can be made without departing from the scope and spirit of the present invention. The dual port memory 750 is in turn connected to the internal DSP data bus 778 of the sub-assembly 770.

The dual port memory 750 preferably comprises two pages, page 0 and page 1. Both pages 0 and 1 are coupled to the minirack modules controller 710 and to the DSP data bus 778. The signal processing sub-assembly includes a number N of digital signal processors 772, 774, 776 which are coupled to each other by the DSP data bus 778.

With reference to Fig. 7A, each minirack module 720, 730 implements an address bus 724, 734 that is local to the module as well as a shared minirack module bus 740. The minirack module bus 740 is connected to every minicard 726, 728, 736, 738 contained in all of the minirack modules 720, 730. Further, the minirack modules controller 710 is coupled between the main minirack module bus 740 and the digital signal processors 772, 774, 776 of the sub-assembly 770 shown in Fig. 7B. The minirack modules controller 710 acts as a buffer between the digital signal processors 772, 774, 776 and the main minirack module bus 740. The minirack modules controller 710 is thereby able to free up the digital signal processors 772, 774, 776 to perform processing and allow full bus bandwidth to be gained from the minirack module bus 740.

The internal module address bus 724, 734 of minirack module 720, 730 allows the interface for each minicards 726, 728 and 736, 738 of module 720, 730 to be identical regardless of which module the minicard is plugged into. The module controller 722, 732 in each module 720, 730 acts to determine if the respective module 720, 730 is being addressed over the minirack module bus 740. The minirack module bus 740 is a physical daisy chain connected by cabling between the module 720, 730 in the computer. Each minirack module 720, 730 has a connection point where the minirack module bus 740 comes in from either the minirack module controller 710 or the previous module 720, 730 in the daisy chain. Each minirack module also has a point where the cable leaves the minirack module to go either to the next minirack module or to be connected to a cable terminator.

Each minirack module 720, 730 has a soft physical address. At startup of the digital signal processors on the sub-assembly 770, the digital signal processor 772 addresses module "0" via the minirack modules controller 710. Consequently, only the minirack module with the terminator connected to it responds as module "0". The digital signal processor 772 then assigns that module (e.g., minirack module 730) a physical address other than zero ("0"). Upon receiving this command, the module controller 732 of the minirack module 730 sets the appropriate bits on its input bus

(i.e., minirack module bus 740) to indicate to the minirack module next to it in the daisy chain that the minirack module 730 is now prepared to respond to commands at module address "0". This process is continued until all the minirack modules have been assigned a physical address.

The minirack modules 720, 730 each contain a modular controller 722, 732. The module controllers 722, 732 are "fixed" minicards engaged in the minirack module display a logical module ID using a seven segment display that is preferably provided on the corresponding control panel. The logical module ID may or may not be the same as the physical address.

The minirack modules controller 710 has two modes: a configuration mode and a run mode. In the configuration mode, the digital signal processor 772 of the sub-assembly 770 gives the minirack modules controller 710 a series of commands to determine an ordered list of accesses to the minirack module bus 740 that the controller 710 is to make once, and only once, for every sample period in the run mode. The minirack modules controller is provided with sample clock (F_S) 712. This is used to drive the minirack modules 720, 730 over the minirack module bus 740. In turn the module controller 722 ticks on each sample clock and accordingly the corresponding minicards respond once per sample time. The sample clock is thereby applied to all the component devices at one time. Bus transmissions are controlled by the minirack modules controller 710 which has the ordered list to be carried out once per sample time.

In the run mode, the minirack modules controller 710 effects transfers between the minirack module bus 740 and the dual port memory 750 shown in Fig. 7B. This does not involve any interaction by the digital signal processors 772, 774, 776 of the sub-assembly 770. Again, the dual port memory 750 is divided into two pages, page 0 and page 1. The minirack modules controller 710 writes or reads the dual port memory 750 for consecutive samples from alternate pages of the memory 750. Any of the number N of digital signal processors 772, 774, 776 of the sub-assembly 770 can access

the dual port memory via the DSP data bus 778 from either page in either of the configuration and run modes.

Finally, as referred to above, each of the minicards 726, 728, 736, 738 contains one or more similar or different elemental instrumentation units for implementing specific functionality that can be carried out in a single sampled time.

The soft physical addressing of the minirack modules 720, 730 allows a "plug and play" type use of the minirack module bus 740. Advantageously, there are no DIP switches to be set on any minirack module 720, 730 when adding a new minirack module to an existing system. Further, bus clashes can be prevented since two minirack modules cannot be set to respond at the same address. Still further, removing a minirack module from the system simply causes a renumbering of the remaining minirack modules 720, 730.

By separating the physical and logical (displayed) addresses of the minirack modules, the preferred embodiment is able to allow continuity for the user in a system where a minirack module has been added or removed. The logical address is the address referred to in the icon representing the instrumentation element in software executed by the system software. Separating the physical and logical addresses also allows the user to reconfigure the numbers of minirack modules without changing any cables or switching any switches.

While only a small number of embodiments have been described, it will be apparent to a person skilled in the art that modifications and/or changes can be made thereto without departing from the scope and spirit of the present invention.

Claims:

1. A data acquisition and generation system for a computer, said system comprising:

at least one module adapted for mounting in a floppy disc bay of said computer and being removable therefrom, said module having a plurality of slots that open forwardly of said module;

at least one functional circuit adapted for interchangeable and removable engagement within a slot of said plurality of slots.

2. The system according to claim 1 wherein said at least one functional circuit is a data acquisition and generation circuit having at least one electrical connector for receiving a digital signal, providing a digital signal, or both.

3. The system according to claim 1, wherein said at least one functional circuit is a data acquisition and generation circuit having at least one electrical connector for receiving an analog signal, providing an analog signal, or both.

4. The system according to claim 1, wherein said at least one module comprises interface means for engagement with said at least one functional circuit and being electrically coupled with said computer.

5. The system according to claim 4, wherein said interface means has a plurality of first predetermined connection means for coupling with a functional circuit, wherein said plurality of first connection means each are aligned with a corresponding one of said plurality of slots.

6. The system according to claim 5, wherein said at least one functional circuit has a second predetermined connection means for mating engagement with a first predetermined connection means.

7. The system according to claim 4, wherein said at least one functional circuit comprises identification means for providing information about said at least one functional circuit to said interface means.

8. The system according to claim 1, wherein said module comprises a front panel for manually operating said module and said at least one function circuit and for displaying information.

9. The system according to claim 1, wherein two or more functional circuits are engaged in corresponding slots of said at least one module, each having a predefined interface for receiving electrical signals, providing electrical signals, or both.

10. The system according to claim 7, further comprising connector interface means for engagement with said predefined interface of each of said two or more functional circuits and for providing at least one application electrical connector for engagement with a signal coupling means, said at least one application electrical connector being coupled to said predefined interfaces.

11. The system according to any one of claims 1 to 10, wherein one ore more elemental instrumentation units are implemented on one or more functional circuits.

12. The system according to claim 11 wherein at least one of said elemental instrumentation units contains circuit switching for safety protection and/or operation of an input and/or output signal between the elemental instrumentation unit and another elemental instrumentation unit.

13. The system according to claim 12, wherein interconnection between said one elemental instrumentation unit and said other elemental instrumentation unit causes said elemental instrumentation units to function as a composite instrument programmed by said computer in combination with a signal processing sub-assembly to emulate a scientific instrument or controller.

14. The system according to claim 7 wherein, at least one elemental instrumentation unit is implemented on said functional circuit and said identification means provides said information about a physical address derived from the mounting position of said functional circuit within said one or more modules.

BNSDOCID: <WO 9749025A1>

15. The system according to any one of claim 11 to 14 wherein each elemental instrumentation unit provides at least one sample per sample period provided by said sub-assembly.

16. The system according to any one of claims 1 to 15 where one functional circuit has a front panel for manual operation of said module and optionally has a display means for displaying information.

17. The system according to any one of claims 1 to 16 further comprising application-specific interface means for coupling with one or more of said functional circuits and providing at least one standard electrical connection dependent on the application.

18. The system according to claim 17 wherein said application-specific interface means comprises a circuit board and means for coupling at least two functional circuits in said module by interengagement with a connector of each of the functional circuits.

19. The system according to any one of claims 1 to 18 wherein each functional circuit is implemented on a printed circuit board.

AMENDED CLAIMS

[received by the International Bureau on 13 October 1997 (13.10.97); original claims 1-3 amended; remaining claims unchanged (1 page)]

1. A data acquisition and generation system for a computer, said system comprising:

at least one module adapted for mounting in a floppy disc bay provided in the front of said computer and being removable therefrom, said module having a plurality of slots that open forwardly of said module;

one or more functional circuits adapted for interchangeable and removable engagement within a slot of said plurality of slots, wherein at least one of said functional circuits is a data acquisition and generation circuit adapted for acquiring an input signal, generating an output signal, or both.

2. The system according to claim 1 wherein said at least one data acquisition and generation circuit has at least one electrical connector for receiving a digital signal, providing a digital signal, or both.

3. The system according to claim 1, wherein said at least one data acquisition and generation circuit having at least one electrical connector for receiving an analog signal, providing an analog signal, or both.

4. The system according to claim 1, wherein said at least one module comprises interface means for engagement with said at least one functional circuit and being electrically coupled with said computer.

5. The system according to claim 4, wherein said interface means has a plurality of first predetermined connection means for coupling with a functional circuit, wherein said plurality of first connection means each are aligned with a corresponding one of said plurality of slots.

6. The system according to claim 5, wherein said at least one functional circuit has a second predetermined connection means for mating engagement with a first predetermined connection means.

7. The system according to claim 4, wherein said at least one functional circuit comprises identification means for providing information about said at least one functional circuit to said interface means.

STATEMENT UNDER ARTICLE 19

In relation to PCT Application No. PCT/AU97/00378, claim 1 has been amended to recite that the floppy disc bay is provided in the front of the computer. Consequently, the plurality of slots provided in the module that open forwardly of the module, also open forwardly of the computer. The citations do not disclose or suggest this feature.

Further, claim 1 has been amended to recite that at least one of the functional circuits is a data acquisition and generation circuit adapted for acquiring an input signal, generating an output signal or both. It is likewise submitted that the citations do not disclose or suggest this feature. Finally, none of the citations disclose or suggest the particular combination of features recited in claim 1.

Further, minor amendments have been made to dependent claims 2 and 3 to reflect the amendments made to independent claim 1 so as to provide a proper antecedent basis for the features recited therein. Claims 4 to 19 remain unchanged.

BNSDOCID: <WO 9749025A1>

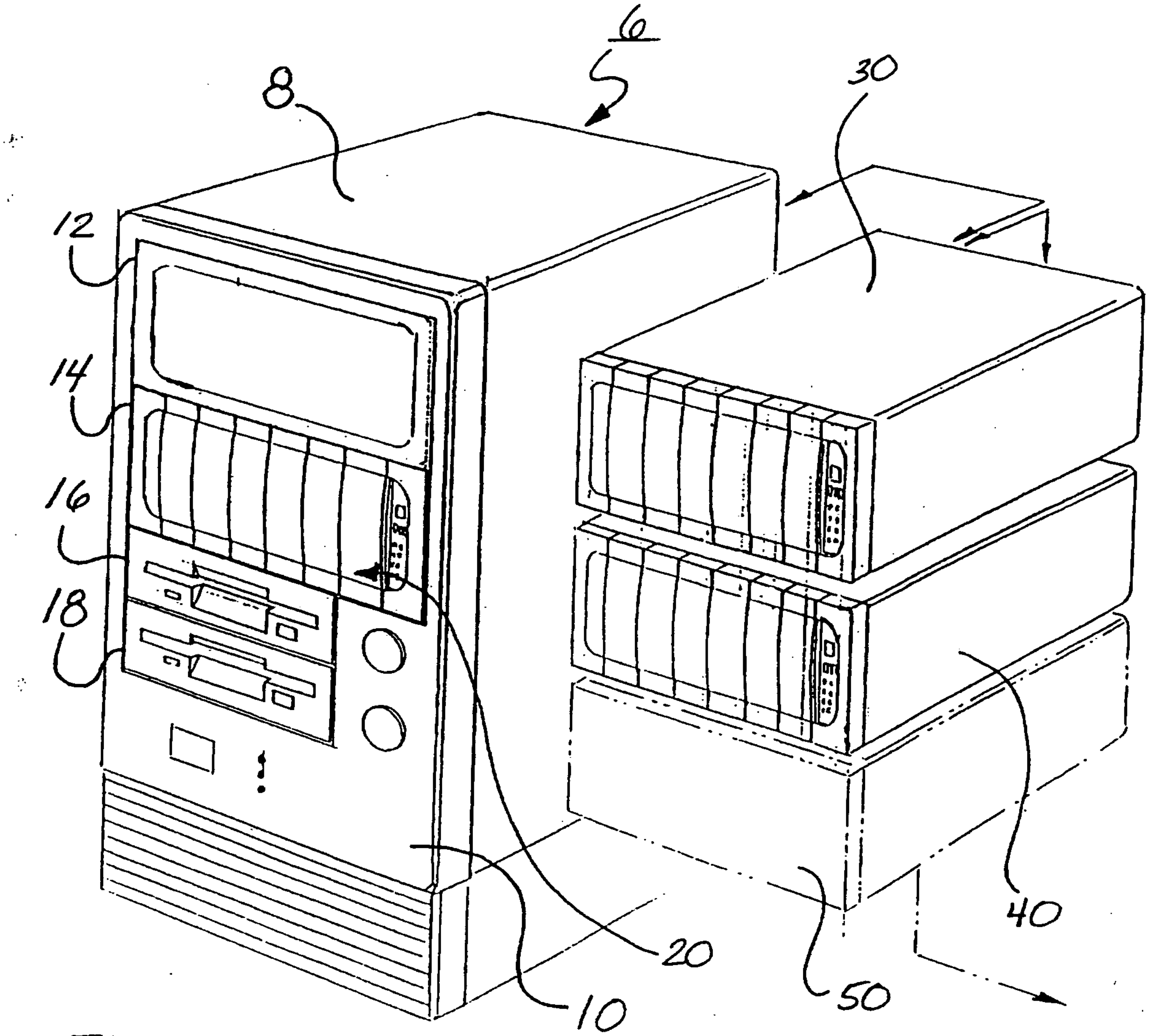


FIG. 1

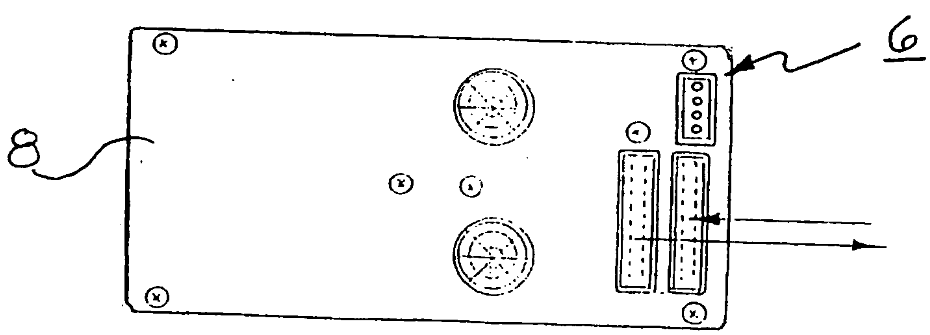


FIG. 4

BNSDOCID: <WO 9749025A1>

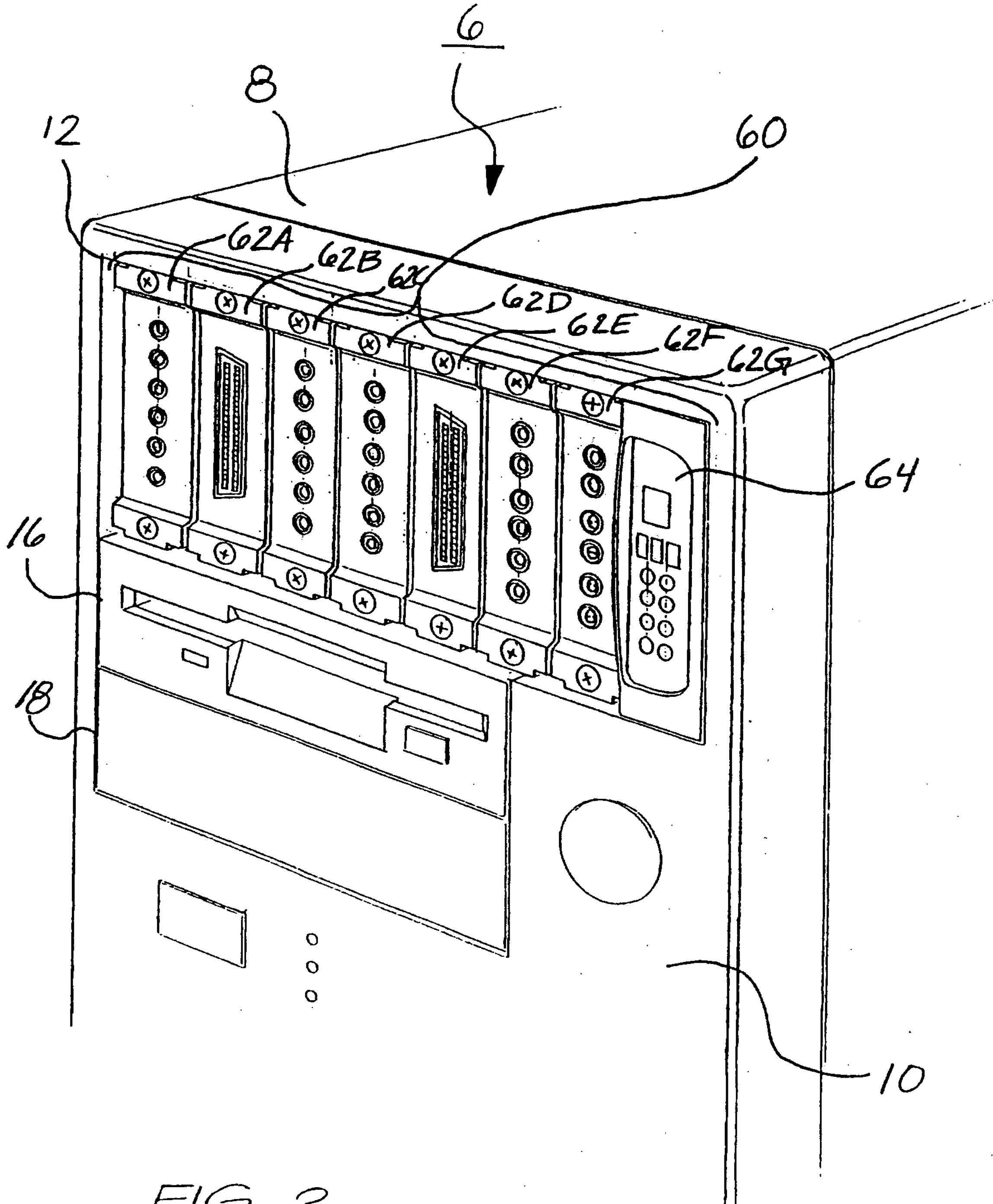


FIG. 2

BNSDOCID: <WO 9749025A1>

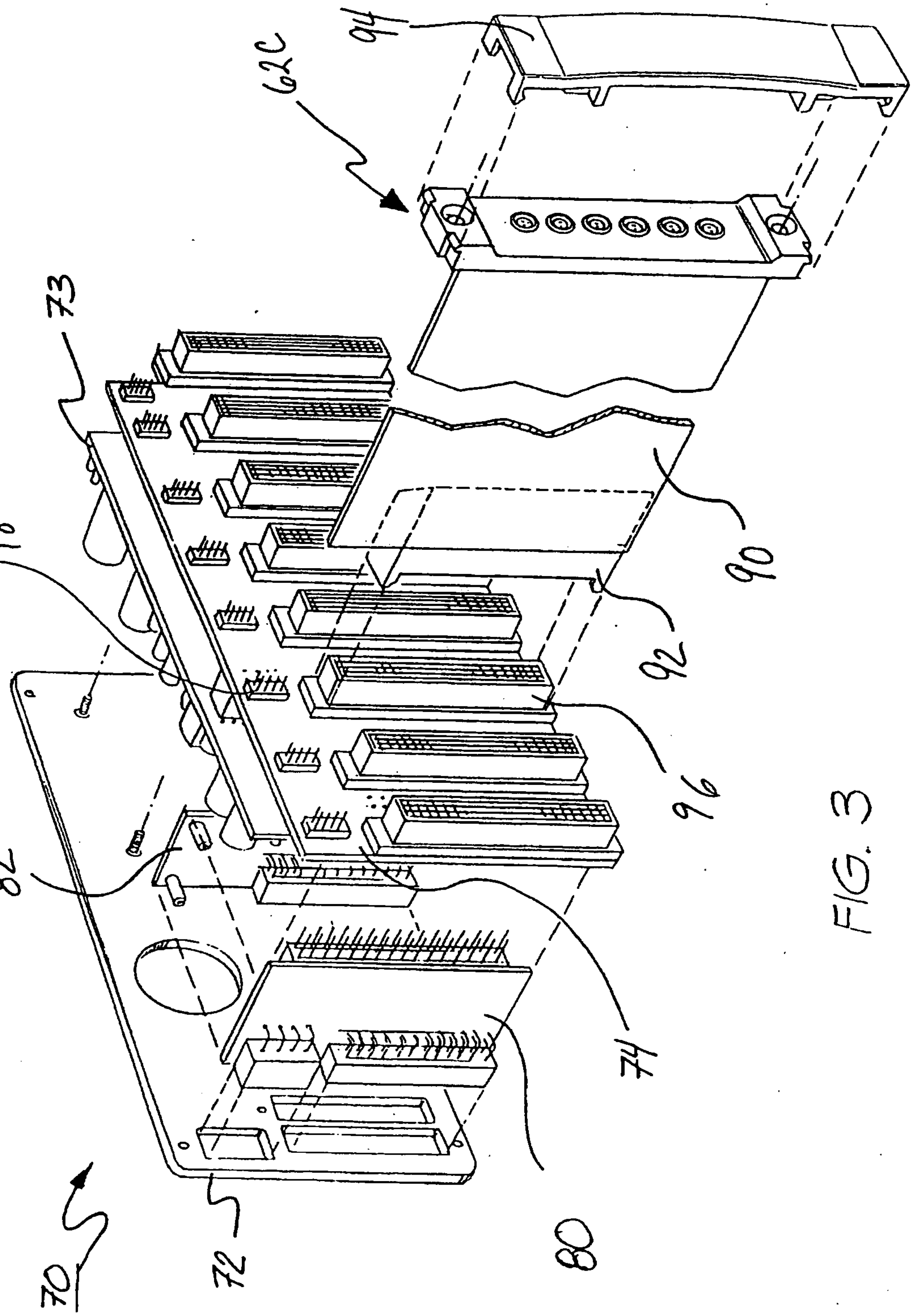


FIG. 3

3NSDOCID: <WO 9749025A1>

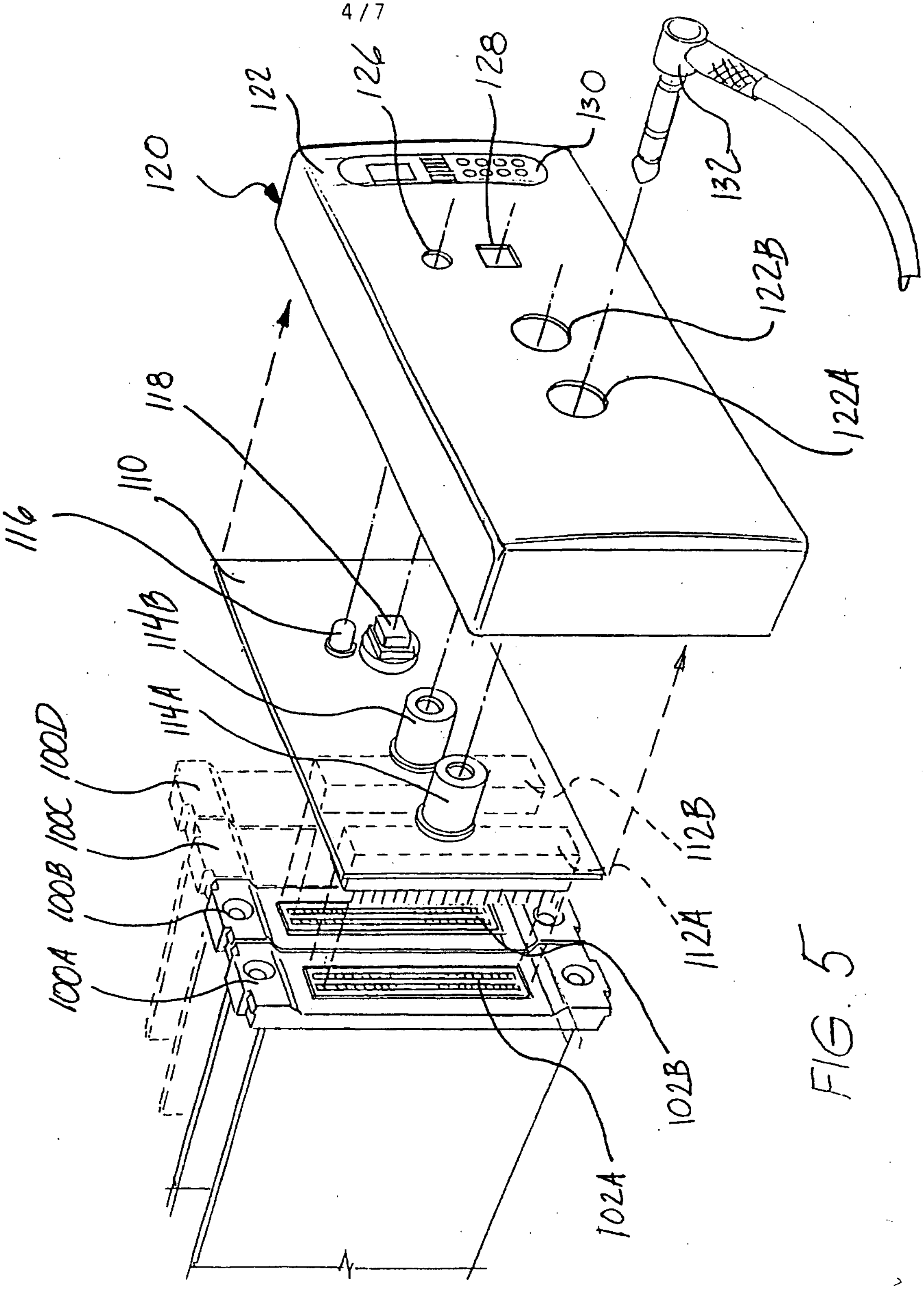


FIG. 5

BNSDOCID: <WO 9749025A1>

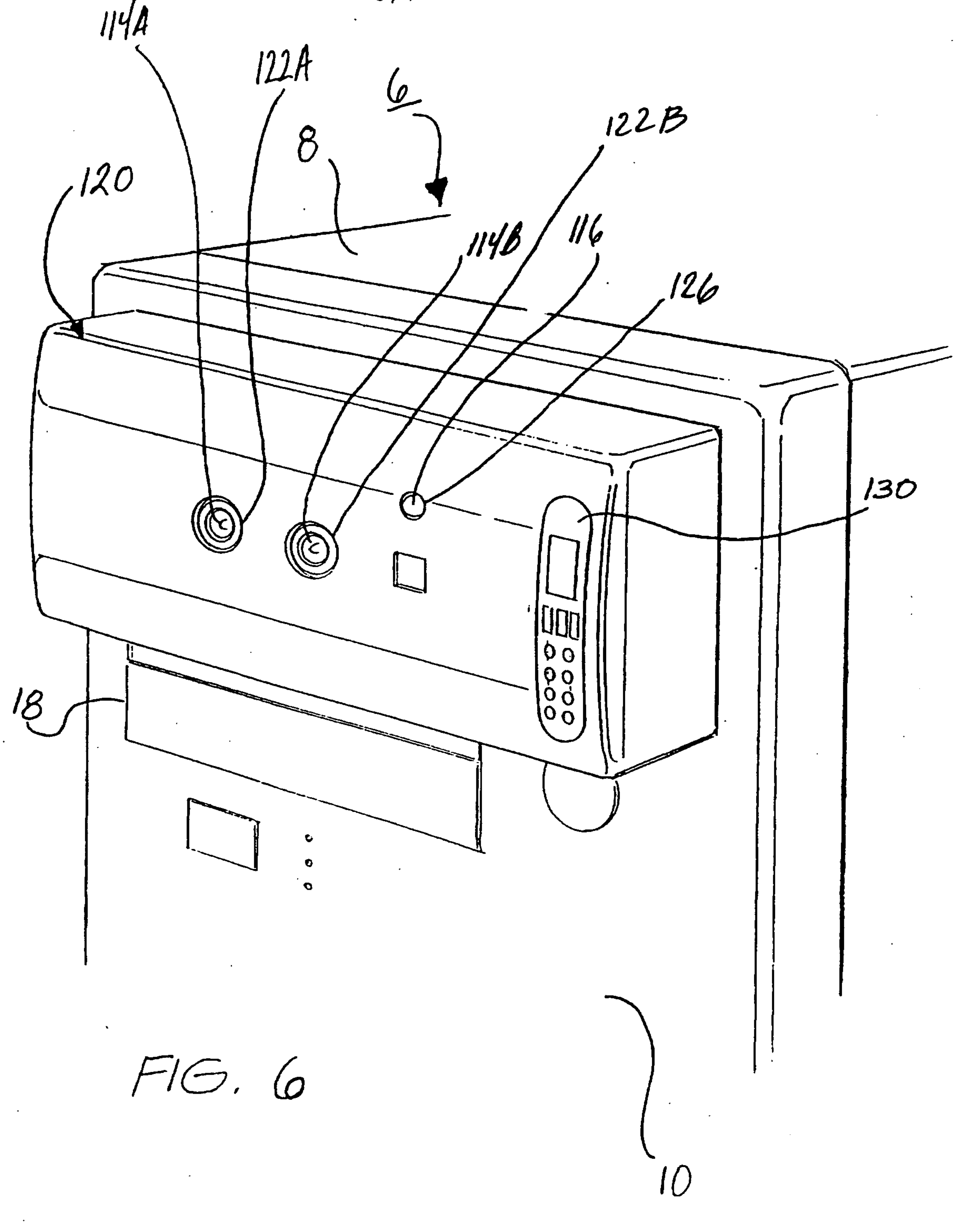
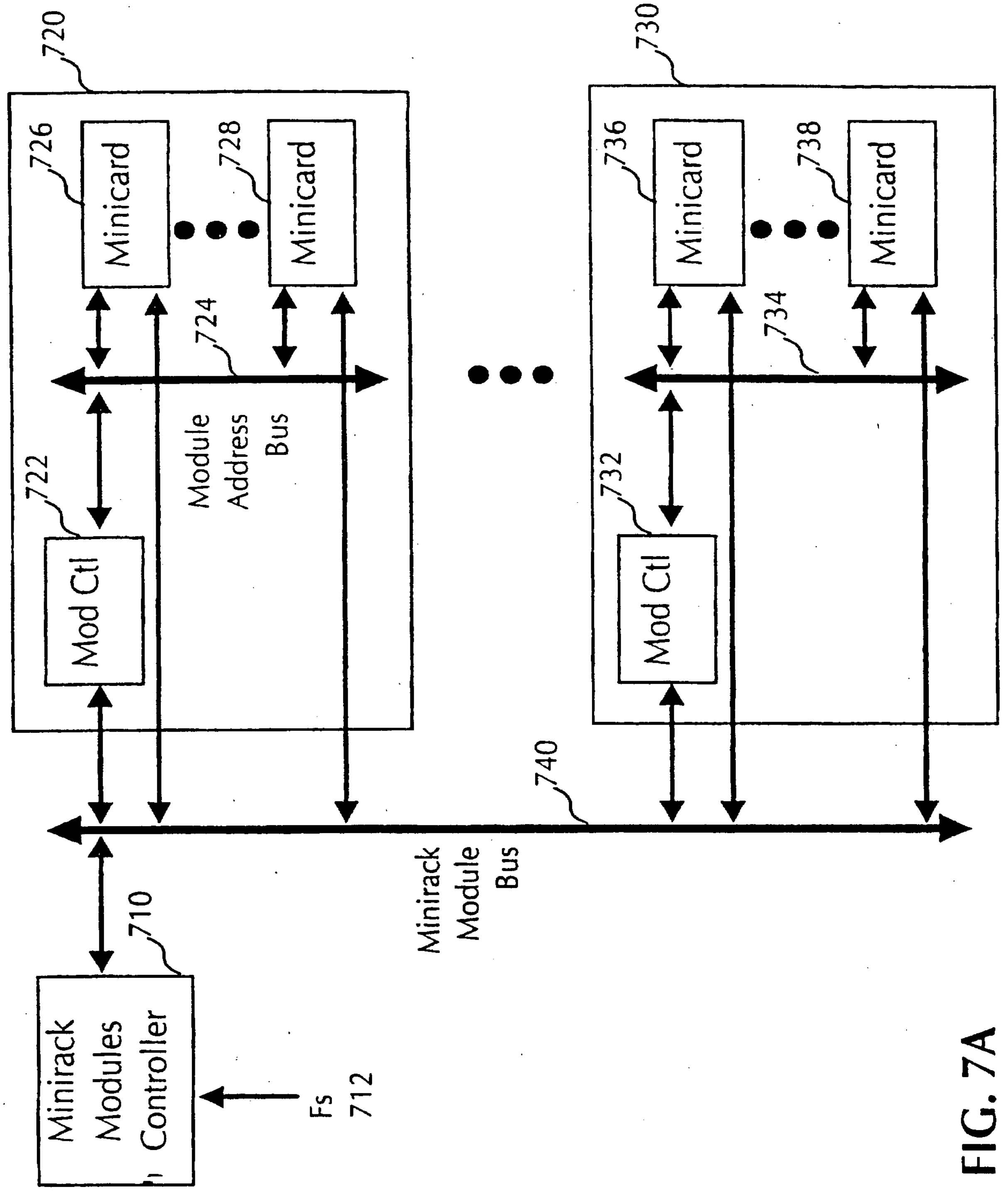


FIG. 6

3NSDOCID: <WO 9749025A1>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726
Minicard
728
Minicard
724
Module
Address
Bus
722
Mod Ctl
730
736
Minicard
738
Minicard
734
732
Mod Ctl
740
Minirack
Module
Bus
710
Minirack
Modules
Controller
Fs
712

FIG. 7A

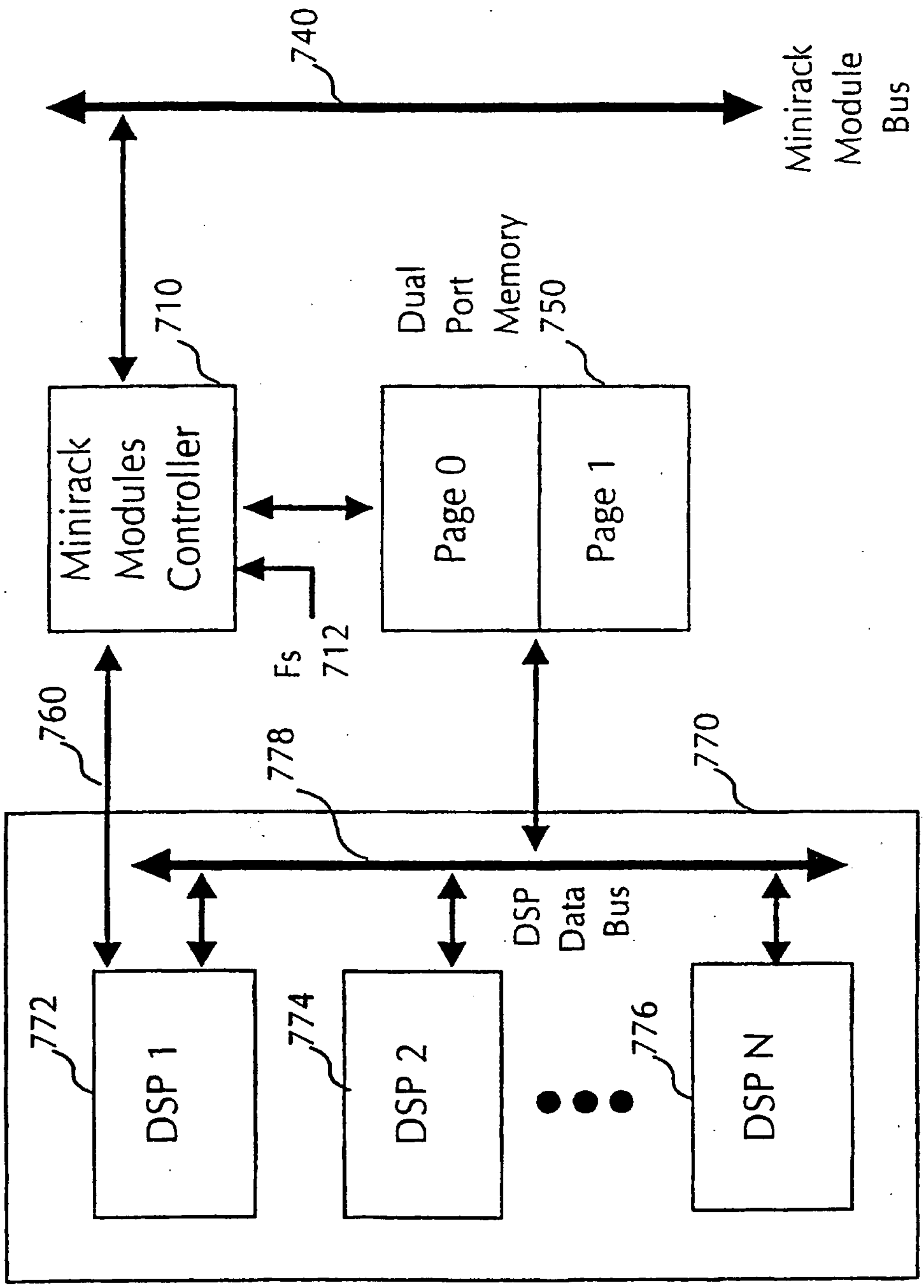
740
Minirack Module Bus
710
Minirack Modules Controller
Fs 712
Dual Port Memory 750
Page 0
Page 1
760
778
770
DSP Data Bus
772
DSP 1
774
DSP 2
776
DSP N

FIG. 7B

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 97/00378

A.	**CLASSIFICATION OF SUBJECT MATTER**
Int Cl^{6}: G06F 1/18, 17/40 H05K 7/10	
According to International Patent Classification (IPC) or to both national classification and IPC	

B.	**FIELDS SEARCHED**
Minimum documentation searched (classification system followed by classification symbols) IPC as above plus G12B 9/XX, G06F 15/74, G06F 3/05	
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU : IPC as above	
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) WPAT, INSPEC (Modul:, interface, circuit)	

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	WO 92/15959 (Associative Measurement Pty) 17 September 1992	
X	whole document especially page 5, lines 3-10, page 6, lines 31-35	1, 2, 3, 4
Y		5, 6, 8
	WO 96/02031 (Apple Computer) 25 January 1996	
Y	Abstract, Figures	8
	US 4831634 (McNally et al) 16 May 1989	
Y	Whole document	5, 6

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 August 1997	15 AUG 1997
Name and mailing address of the ISA/AU AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (06) 285 3929	Authorized officer **DALE SIVER** Telephone No.: (06) 283 2196

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 97/00378

C (Continuati n) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 520173 (Tandon Corporation) 30 December 1992 Abstract, Figures	
A	EP 464658 (IBM) 8 January 1992 Whole document	

INTERNATIONAL SEARCH REPORT
Information on patent family members

International Application No.
PCT/AU 97/00378

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	9215959	AU	13249/92	EP	573503	JP	6508430
WO	9602031	AU	29637/95	US	5600538		
US	4831634	AU	38087/89				
EP	520173						
EP	464658	DE	69112145	JP	4281508		

END OF ANNEX